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EXAMINER
FULLER, ERIC B

ART UNIT	PAPER NUMBER
1762	7

DATE MAILED: 10/24/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/837,265	CHURCH ET AL.	
	Examiner	Art Unit	
	Eric B Fuller	1762	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *08 July 2002* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-46* is/are pending in the application.

4a) Of the above claim(s) *29-42* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-28 and 43-46* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1-28 and 43-46 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention. Applicant has added, by amendment to the claims, that the coating material includes individual particles and that these particles are sintered together. Examiner fails to find support for this limitation. The present invention specifically teaches that the material is a paste and is sintered to the substrate (page 4, line 1-10; page 7, lines 5-15); no reference is made that the paste comprises particles. The only reference made to particles is present in the background discussion (page 1). However, this fails to teach that the material of the present invention includes particles.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in-

> (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effect under this subsection of a national application published under section 122(b) only if the international application designating the United States was published under Article 21(2)(a) of such treaty in the English language; or
> (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that a patent shall not be deemed filed in the United States for the purposes of this subsection based on the filing of an international application filed under the treaty defined in section 351(a).

Claims 1-10, 12, 14, and 15 are rejected under 35 U.S.C. 102(e) as being anticipated by Wadman (US 6,451,387 B1).

Wadman teaches a process where ceramic powder is applied to a low temperature substrate (abstract). A pulsed laser is used in order to compact the powder and sinter it to the substrate (column 1, lines 45-67). The depth (heating) of the laser is controlled (column 2, lines 43-67). The laser may heat the ceramic layer or the substrate, or both (column 3, lines 1-8). When heating the substrate at the surface (penetration of laser is the thickness of the coating material), no thermal gradient exists between the ceramic layer and the substrate and the adhesion between the two is increased. When the laser heats the ceramic layer only, the particles are sintered together and the adhesion to the substrate is unaffected (column 2, lines 43-67; column 3, lines 1-8). Optimizing the pulse duration of the laser by minimizing it controls the diffusion of heat and keeps the substrate from being damaged (column 1, lines 55-60).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-3, 7-16, and 21-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kirkpatrick (US 4,151,008) in view of Abe (US 5,746,868).

Kirkpatrick teaches a process where a laser is used to perform a heat treatment process on a substrate. The treatment may be sintering a metal-semiconductor interface (column 5, lines 55-60). The laser is aimed at the material to be sintered and in doing so creates the thermal energy needed (column 4, lines 4-10). The pulse duration of the laser is set such that only selected surface vicinity regions are heated and that the substrate is not subjected to undesirable high temperatures (column 6, lines 1-7; column 2, lines 1-10), thus reading on "without damaging the substrate". The reference fails to teach that the material being sintered comprises metal particles that are sintered together. However, Abe teaches a process for laser sintering a metal-semiconductor interface that is performed by applying a paste comprising metal particles to the semiconductor substrate (column 4, lines 9-21; column 6, lines 1-8). To have the metal material being sintered in Kirkpatrick be in the form of a paste comprising metal particles would have been obvious at the time the invention was made to a person having ordinary skill in the art with the expectation of achieving similar results as both references act to laser sinter a metal-semiconductor interface without causing damage to the substrate. The metal particles would inherently sinter together when being sintered to the substrate.

As to claim 7, the exposure times for providing complete heating are set (column 1, lines 53-68; column 3, lines 50-51).

As to claim 8, the reference teaches a process for localizing the heat such that heat is not dissipated from the process region (column 3, lines 55-57). However, for the embodiment of where the metal-semiconductor interface is being sintered, the entire metal material would be considered the process area and diffusion of heat throughout the metal material would be inherent.

As to claim 9, the laser provides high energy that is injected into the material and the material translates this injected energy into heat (column 4, lines 4-10).

As to claim 10, the absorption behavior and effects of pulse duration have been determined in the reference (column 1, lines 54-58; column 2, lines 1-56).

. As to claim 11, the reference also teaches to use low energy per pulse and short pulse durations. The reference is silent to the peak power being in the gigawatt range. However, it would have been obvious at the time the invention was made to a person having ordinary skill in the art to use peak powers sufficient enough to sinter the metal material without causing damage to the substrate. To determine what this value is would be within the skill of one practicing in the art through routine experimentation. It is the examiners position that since the reference is using energies and pulse durations near that of the applicant, the peak power that is sufficient to sinter the material would be within the applicant's claimed range.

As to claim 12, Kirkpatrick teaches to control the pulse duration to achieve the desired energy penetration, but is silent to optimizing it. However, optimizing a parameter is obvious to one skilled in the art.

As to claim 13, the reference, in one embodiment, teaches to sinter only surface vicinity regions (column 6, line 6). This reads on not sintering a middle or bottom layer.

As to claim 14, controlling the pulse duration of the laser determines the penetration depth of the energy injected into the material (column 3, lines 46-60).

As to claim 15, Kirkpatrick teaches to sinter the metal-semiconductor interface to improve mechanical adherence (column 5, lines 55-60). It would have been obvious at the time the invention was made to a person having ordinary skill in the art, from reading this line, to control the pulse duration such that the penetration depth of the energy is equal to the thickness of the metal material. By doings so, the effects that are taught desired by Kirkpatrick are achieved.

As to claim 16, Kirkpatrick fails to teach to monitor the behavior of the heat in the material. However, to do so would have been obvious to one skilled in the art in order to achieve uniformity and reproducibility of multiple applications of the process. A thermal-imaging camera, being known in the art, would have been an obvious way to do this.

As to claim 21, the selected surface vicinity being sintered in the reference qualifies as "sintering at least one thin top layer of the material".

As to claim 22, the effect of a mirror forming on the top layer of the material, such that energy is diverted from the material in order to prevent sintering from occurring throughout the material, would be inherent to the process of sintering only the selected surface vicinity of a metal material. The examiner's position on this being an inherent

process is due to the materials and laser parameters of the reference are similar to that of the applicantion.

As to claim 23, to have a feedback control system would also have been obvious at the time the invention was made to a person having ordinary skill in the art in order to ensure reproducibility of the process.

Claims 1-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sopori (US 5,223,453) in view of Abe (US 5,746,868).

Sopori teaches a process where metal is deposited on top and on bottom of a semiconductor substrate (abstract). The metal on the top is to be sintered and the metal on the bottom is to be alloyed. This is done without overheating the sintered material or the substrate (column 4, lines 54-61), thus reading on "without damaging the substrate". Illuminating the substrate, with the two layers deposited on it, with electromagnetic radiation (column 5, lines 24-50) through the top layer (the layer that is to be sintered) performs both the alloying and the sintering. The radiation causes the surface of the top layer to convert some of the energy to heat. The substrate also heats up, from the bottom, as a result of the radiation. This causes the thermal energy to spread throughout the top layer. The reference teaches that the radiation is produced from a radiation lamp. However, to substitute a laser for the lamp would have been obvious to one of ordinary skill in the art. By doing so, more control of the radiation to selected areas is possible.

The reference fails to teach that the material being sintered comprises metal particles that are sintered together. However, Abe teaches a process for laser sintering a metal-semiconductor interface that is performed by applying a paste comprising metal particles to the semiconductor substrate (column 4, lines 9-21; column 6, lines 1-8). To have the metal material being sintered in Sopori be in the form of a paste comprising metal particles would have been obvious at the time the invention was made to a person having ordinary skill in the art with the expectation of achieving similar results as both references act to laser sinter a metal-semiconductor interface without causing damage to the substrate. The metal particles would inherently sinter together when being sintered to the substrate.

As to claim 5, during radiation, the top layer is being sintered and adhesion to the substrate is being promoted. The teaching of hot spots and secondary hot spots (column 6, lines 41-68) shows that the temperatures of the substrate and the top material, at the interface, are similar during radiation.

As to claim 6, when the radiation is stopped, the sintering stops. There would be no increase in adhesion after the sintering has stopped as a result of the radiation stopping. The teachings of hot spots and secondary hot spots (column 6, lines 41-68) shows that the hottest spot of the system, during radiation, would exist at the bottom of the substrate. Because of this uneven heating and the differences in thermal conductivity between the substrate and the metal material, the cooling of the system after the radiation has stopped would not be uniform. This results in a temperature

gradient between the top material and the substrate. This reads on the "temperature gradient stops the adhesion".

Claims 17-20 and 43-46 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kirkpatrick (US 4,151,008) in view of Abe (US 5,746,868), as applied to claim 1 above, and further in view of Ladd et al. (US 6,100,463).

Kirkpatrick in view of Abe teach the limitations of claim 1 and further teaches that it is undesirable to subject semiconductor substrates devices to high temperatures (Kirkpatrick -column 2, lines 5-10). The references fail to teach the use of a thermal barrier layer over the substrate in order to protect the substrate from the heat associated with sintering. However, Ladd teaches that aerogels are used as spacer materials when thermally isolating portions of a semiconductor wafer (column 4, lines 15-30). Therefore, it would have been obvious at the time the invention was made to a person having ordinary skill in the art to utilize aerogel, as a thermal barrier, to protect the substrate from damage from the heat produced by the sintering process. Since the materials in the reference are the same as that claimed by the applicant, it is the examiner's position that it is inherent that the aerogel also acts to increase adhesion of the sintered material. As to claims 20 and 41, the semiconductor device taught by Kirkpatrick is an electronic component with a low temperature substrate.

Claims 24-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kirkpatric (US 4,151,008) in view of Abe (US 5,746,868), as applied to claim 22 above, and further in view of Kriegel et al. (US 6,300,256 B1).

Kirkpatrick in view of Abe teach the limitations of claim 23. Specifically, the limitations of claim 22 are implicitly or inherently taught and the limitations of claim 23, the use of a feedback controller, would have been obvious in order to achieve reproducibility of the process. The references fail to teach the use of a pyrometer with a in order to provide the input of the feedback controller. However, one skilled in the art would recognize that a temperature would be the desired input for the controller. Additionally, Kriegel teaches using a pyrometer having a small measurement spot to determine the temperature of a semiconductor (column 12, lines 5-10). This is done to ultimately control the temperature and temperature gradients of the semiconductor. The benefit of the pyrometer is that the temperature can be determined without contacting the substrate (column 3, lines 35-37). Therefore, it would have been obvious at the time the invention was made to a person having ordinary skill in the art to utilize the pyrometer having a small spot size in order to determine the temperatures at selected areas of the semiconductor without making any contact that might disturb the system.

To have the pyrometer connected to a computer that controls the parameters of the laser would have been obvious to one skilled in the art. It is the examiner's position that the control loop would inherently have to be either open or closed. To provide an interface for real time use by end users, such as to CAD software, would also have

been obvious to one skilled in the art such that full automation can be achieved and design changes are instantaneously performed.

Claims 11, 16, and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wadman (US 6,451,387 B1).

. As to claim 11, the reference also teaches to use low energy per pulse and short pulse durations. The reference is silent to the peak power being in the gigawatt range. However, it would have been obvious at the time the invention was made to a person having ordinary skill in the art to use peak powers sufficient enough to sinter the metal material without causing damage to the substrate. To determine what this value is would be within the skill of one practicing in the art through routine experimentation.

As to claim 16, Wadman fails to teach to monitor the behavior of the heat in the material. However, to do so would have been obvious to one skilled in the art in order to achieve uniformity and reproducibility of multiple applications of the process. A thermal-imaging camera, being known in the art, would have been an obvious way to do this.

As to claim 23, to have a feedback control system would also have been obvious at the time the invention was made to a person having ordinary skill in the art in order to ensure reproducibility of the process.

Claims 17, 18 and 43-45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wadman (6,451,387 B1), as applied to claim 1 above, and further in view of Ladd et al. (US 6,100,463).

Wadman teaches the limitations of claim 1. The references fail to teach the use of a thermal barrier layer over the substrate in order to protect the substrate from the heat associated with sintering. However, Ladd teaches that aerogels are used as spacer materials when thermally isolating portions of a semiconductor wafer (column 4, lines 15-30). Therefore, it would have been obvious at the time the invention was made to a person having ordinary skill in the art to utilize aerogel, as a thermal barrier, to protect the substrate from damage from the heat produced by the sintering process. Since the materials in the reference are the same as that claimed by the applicant, it is the examiner's position that it is inherent that the aerogel also acts to increase adhesion of the sintered material. As to claims 20 and 41, the substrate taught by Kirkpatrick is a low temperature substrate.

Response to Arguments

Applicant's argues that none of the references previously cited teach the limitation that the sintered material comprises particles, as added by amendment. Examiner agrees and has therefore applied new grounds of rejection in this Office Action that take into account this added limitation. The applicant's arguments are moot in view of the new grounds of rejection.

Conclusion

Applicant's amendment necessitated the new grounds of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eric B Fuller whose telephone number is (703) 308-6544. The examiner can normally be reached on Mondays through Thursdays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shrive Beck, can be reached at (703) 308-2333. The fax phone numbers for the organization where this application or proceeding is assigned are 703 872-9310 for regular communications and (703) 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

EBF
October 20, 2002

FRED J. PARKER
PRIMARY EXAMINER